EXHIBIT 7
DATE 2-6-07
HB 360

2007 Montana Legislative Session
Montana House of Representatives
Business & Labor Committee

Written Testimony of George Manning
Hillerich & Bradsby Co.

HB 360

I am pleased to have this opportunity to present information to you. My education and life work has been as a mechanical engineer. Since 1979 I have been associated with Louisville Slugger in different capacities. Louisville Slugger has been making wood bats for over 120 years and non-wood bats for over 25 years. The good of the game of baseball is and has been very important to Louisville Slugger throughout these years. If Baseball were to become or perceived to be an unsafe game that is not good for anyone involved in it.

Today I am here to provide information relevant to your consideration of HB 360. I am also prepared to answer questions you may have concerning the science behind the testing requirements mandated on non-wood bats.

Both the U.S. Government through the Consumer Product Safety Commission (CPSC) in 2002, and baseball governing bodies including the NCAA, NFHS, Amateur Baseball and all of its affiliates Little League, Babe Ruth League, American Legion , etc. have looked at and continue to look at the game of recreational and amateur baseball from the balance of offense vs. defense and from a safety viewpoint. The NCAA and others have implemented regulations that have made non-wood bats more like wood bats in batted-ball exit velocity. After careful study in 1998 by a Blue Ribbon Panel made up primarily of physicists, engineers, and medical doctors selected by the Executive Council of the NCAA, an objective three-pronged requirement to address bat performance was established for all non-wood bats in 1999.

First, the bats could not be larger in diameter than 2 5/8". Second, bats could not be lighter than 3 ounces less than their length without their grip (33" bats must not weigh under 30 oz.). Finally, bats must meet a Ball Exit Velocity Ratio "BESR". This BESR limits the exit speed off the non-wood bat in a laboratory setting under a specific test protocol not to exceed the exit speed off the best performing Major League Baseball wood bat. The test protocols and parameters were set to ensure consistent and reliable data. Since 1999, additional requirements such as minimum MOI for non-wood bats have been added (in effect controlling the minimum balance point). I attach a copy of a "white paper" which summarizes these testing requirements. All the governing bodies have reported they are happy with the balance of offense vs. defense and they find there is no evidence that the game with non-wood bats results in a higher safety risk than with wood bats.

I am a member and the immediate past chairman of the Baseball/Softball Council of the Sporting Goods Manufacturer's Association (SGMA). Because some have developed a perception that there may be a greater injury rate and more risk to pitchers with non-wood bats, the Council decided to fund an independent study to determine factual data on this subject. This academic study was publicly announced and began two years ago and is being conducted by Dr. Mueller and his associates at the University of North Carolina. Dr. Mueller is an independent academic and scientist. The funding is provided by SGMA members, but they have no input into the parameters of the study. The selection of study participants and methodology and the reports are strictly independent. The study involves monitoring Division I college players during their collegiate seasons using non-wood bats and many of the same players using wood bats in summer leagues. The study is scheduled to run 3 years, and 2 years of data collection and analysis have been completed. A copy of Dr. Mueller's analysis of the first two years of data is attached. That analysis shows that after two years there is no statistically valid data showing differences in injury rates to pitchers from balls batted with wood and non-wood bats. The injury rate to players from balls batted with both types of bats is very low. The most serious injuries in the study have occurred from balls batted with wood bats.

Based on all information available, the banning of non-wood bats would not increase the safety of the game and is not in the best interests of the game. I urge you to oppose HB 360.

The BESR
(Ball Exit Speed Ratio)

by

Dr. James Ashton-Miller, Dr. Michael Carroll,
Dr. Kenneth Johnson, Dr. Alan Nathan

NCAA Baseball Research Panel

Todd Petr, Ty Halpin

NCAA

Introduction

The NCAA requires that all nonwood bats be certified so as to limit their "liveliness." The certification process is accomplished by measuring the performance of a bat under controlled conditions and then assigning a number to it; this number is known as the BESR (Ball Exit Speed Ratio). To be certified, the BESR of the bat must fall at or below a predetermined value set by the NCAA. This paper discusses the concept of the BESR.

The Ball-Bat Collision

Figure 1 shows a ball and a bat just before the collision and the ball just after the collision (the position of the ball after the collision has been moved downward for the sake of clarity).

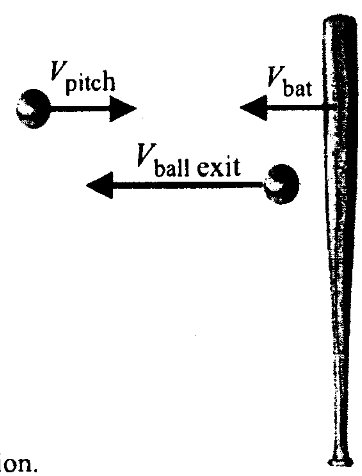


Figure 1 The ball-bat collision.

The speeds involved in the collision are:

V_{pitch} = speed of the pitched ball just before it collides with the bat.

V_{bat} = speed of the bat just before it collides with the ball. This is the bat speed at the point of impact.

$V_{\text{ball exit}}$ = exit speed of the ball just after it leaves the bat.

What Is the BESR?

The BESR is a number, once known, that allows one to determine the ball exit speed $V_{\text{ball exit}}$ when the bat speed V_{bat} and the pitch speed V_{pitch} are specified. The relationship between the BESR and these speeds is:

$$V_{\text{ball exit}} = \left(\text{BESR} + \tfrac{1}{2}\right)V_{\text{bat}} + \left(\text{BESR} - \tfrac{1}{2}\right)V_{\text{pitch}} \tag{1}$$

'As an example, suppose the BESR for a particular ball-bat collision is 0.65, and that the bat and pitch speeds are $V_{\text{bat}} = 70$ mph and $V_{\text{pitch}} = 75$ mph. The ball exit speed would be

$$V_{\text{ball exit}} = \left(0.65 + \tfrac{1}{2}\right)(70\text{ mph}) + \left(0.65 - \tfrac{1}{2}\right)(75\text{ mph}) = 92\text{ mph}$$

Conversely, if one measures the bat speed, the pitch speed, and the ball exit speed, then Equation 1 can be used to determine the BESR (see Equation 2 below).

Note from Equation 1 that greater values of the BESR give rise to greater ball exit speeds. Therefore, the BESR is a measure of the "liveliness" of the ball-bat collision and it includes, for example, any "trampoline" effect that the non-wood bat may display (due to its barrel being temporarily deformed by the ball during the collision).

Where does the BESR get its name?

When one algebraically solves Equation 1 for the BESR the result is

$$\text{BESR} = \frac{V_{\text{ball exit}} + \frac{1}{2}\left(V_{\text{pitch}} - V_{\text{bat}}\right)}{V_{\text{pitch}} + V_{\text{bat}}} \tag{2}$$

When the speeds of the pitched ball and bat are the same ($V_{\text{pitch}} = V_{\text{bat}}$), Equation 2 becomes

$$\text{BESR} = \frac{V_{\text{ball exit}}}{V_{\text{pitch}} + V_{\text{bat}}}$$

We see in this case that the BESR is equal to the ratio of the ball exit speed $V_{\text{ball exit}}$ to the relative speed ($V_{\text{pitch}} + V_{\text{bat}}$) of the pitched ball and bat before the collision. Hence, the name "Ball Exit Speed Ratio."

How does the BESR Depend on the Properties of the Ball and Bat?

Figure 2 illustrates a ball just before colliding with the bat. The bat is assumed to be clamped in a hitting machine and is free to rotate in the plane of the paper about the pivot point.

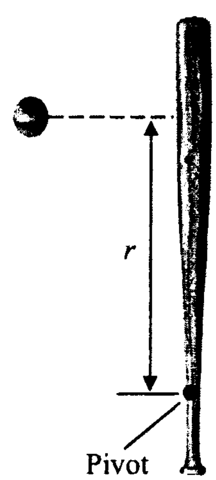


Figure 2 The bat pivot point and the distance *r* from the pivot point to where the ball collides with the bat.

The physics of the collision is described by applying the law of conservation of angular momentum to the ball-bat interaction. When this law is used, along with the definition of the coefficient of restitution (see below), we arrive at Equation 1, where the BESR is given in terms of the properties of the ball and bat as[1,2,3]

$$\text{BESR} = \frac{e + \frac{1}{2}\left(1 - \frac{mr^2}{I_p}\right)}{1 + \frac{mr^2}{I_p}} \tag{3}$$

where

- e = coefficient of restitution of the ball-bat collision. The coefficient of restitution is defined as the ratio of the relative speed of the ball and bat after the collision to that before the collision. Suppose that, before the collision, the ball and bat are moving toward each other with a relative speed of 160 mph. Suppose, further, that after the collision the ball and bat are moving with a relative speed of 80 mph. Then the coefficient of restitution of the ball-bat collision is (80 mph)/(160 mph) = 0.5.
- m = mass of the ball.
- r = distance from the pivot point to where the ball hits the bat (see Figure 2).
- I_p = moment of inertia of the bat about the pivot point. This parameter depends on the mass of the bat as well as how the mass is distributed relative to the pivot point. The more the mass is concentrated away from the pivot point, the larger is the moment of inertia.

Note that the BESR depends on the properties of the ball (m), the bat (I_p), and the ball-bat collision (e and r).

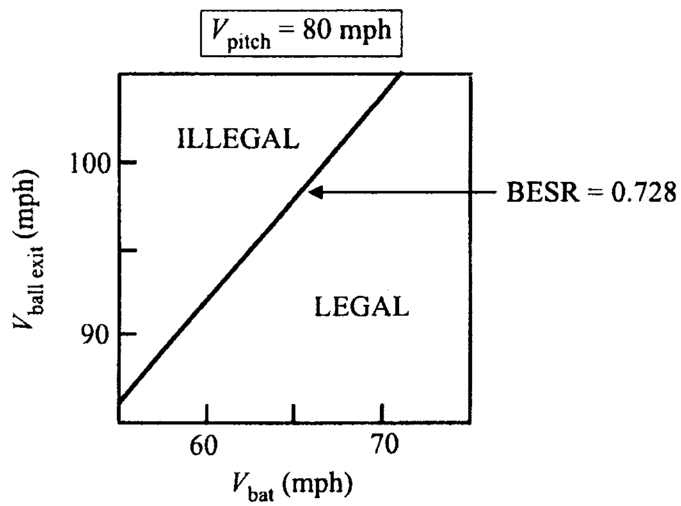
Why Use The BESR Rather Than Specify a Ball Exit Speed?

In general, different bat testing laboratories use different types of hitting machines: (1) the pitched ball is moving and the bat is initially stationary, (2) the ball is stationary and the bat is initially moving, and (3) both the pitched ball and bat are initially moving. Even if each type of hitting machine is set up to have the same relative speed ($V_{pitch} + V_{bat}$) of the pitched ball and bat, the ball exit speeds will be different. However, all types of machines will give the same value for the BESR. This result, while not obvious, is a direct consequence of Equation 1.

What Is The Maximum Allowed Value For The BESR?

When bats were first tested in 1999, an initial lot of baseballs was used. The tests were conducted by using a pitch speed of 70 mph and a bat speed (at a point 6 inches from the end of the barrel) of 66 mph. Under these conditions, the best major league wood bat yielded a BESR of 0.728, which the NCAA then set to be the maximum allowed value.

The graph shows a plot of ball exit speed ($V_{ball\ exit}$) versus bat speed (V_{bat}) for the case when the pitch speed is V_{pitch} = 80 mph. The straight line represents Equation 1 in which the BESR has been set to the legal limit of 0.728. Any bat that gives rise to a ball exit speed at or below this line is legal. Likewise, any bat that produces a ball exit speed above this line is illegal.



Subsequent tests on non-wood bats used different lots of new baseballs. Because the properties of balls differ from lot to lot, even when they are stored and used in a humidity-controlled room, the BESR is adjusted to account for these differences. Therefore, the maximum allowed value for the BESR changes slightly, depending on the particular lot of baseballs used in testing a given non-wood bat. However, in every case, the BESR of the non-wood bat is always compared with that of major league wood bats tested in the same machine with the same lot of baseballs under standardized ball-bat testing conditions.

---

[1]M. M. Carroll, "Assessment and regulation of baseball bat performance," *Symposium on Trends in the Application of Mathematics to Mechanics*, edited by P. E. O'Donoghue and J. N. Flavin (Elsevier, Amsterdam, 2000), p. 17.

[2]A. M. Nathan, "Dynamics of the baseball-bat collision," Am. J. Phys. **68**, 979–990 (2000).

[3]A. M. Nathan, "Characterizing the performance of baseball bats," Am. J. Phys. **71** (2), 134–143 (February 2003).

ANNUAL REPORT

BATTED BALL INJURIES TO THE PITCHER

FREDERICK O. MUELLER, Ph.D.[1]
STEPHEN W. MARSHALL, Ph.D[2]

Departments of Exercise and Sport Science[1] and Epidemiology[2]
University of North Carolina at Chapel Hill
October 9, 2006

PROPOSAL SUMMARY

The researcher's proposal was to conduct a three year observational epidemiological study on injuries from batted balls to the pitcher, comparing the wood bat to the metal bat. Data on injuries from metal bats is being drawn from the National Collegiate Athletic Association's Injury Surveillance System. Data on injuries from wood bats is being prospectively collected by Drs. Mueller and Marshall in the summer collegiate baseball leagues around the country.

The study is collecting data on pitcher's acute injuries in games or practices, with a focus on line drive batted balls. This study will provide an answer to the question of whether the use of metal bats in baseball increases the risk of injury to pitchers from batted balls, relative to use of the wood bat. The study is collecting data for three years – 2005, 2006, 2007.

SAMPLE OF TEAMS

Prior to the data collection period contact was made with the National Collegiate Athletic Association (NCAA) concerning the use of their baseball data from their Injury Surveillance System. They agreed to share data on injuries to the pitcher from batted balls from the metal bat. During the 2006 season the NCAA collected baseball data from 55 teams. We have combined this data with the data from 38 teams that provided data in 2005.

During the summer of 2005 we collected data from 129 summer league teams. In summer of 2006 we collected data from 117 teams. Prior to the 2005 season we mailed letters explaining the research, human subject information, and copies of the injury form to all leagues and teams. In the 2006 season, we re-contacted all teams. The research assistant assisted in all of the mailings, contacted the summer league teams by telephone during the season, and traveled to eight of the 15 leagues to observe games and meet the coaches.

INTERIM ANALYSIS – YEARS 1 & 2

This interim analysis is presented by combining the 2005 and 2006 data. The interim analysis is based the number of injuries to pitchers from a line drive batted ball in which the pitcher had to leave the game, divided by the total number of balls in play. Balls in play are calculated by taking the total number of at-bats and subtracting strike outs and bases on balls in order to give a true picture of how many balls are actually hit into the field of play. We computed this injury rate in the NCAA and in the summer leagues. The ratio of these two rates (NCAA injury rate divided by summer league injury rate) is a measure of the increased "risk" of injury (to pitchers from line drives) in the NCAA (metal bats) relative to summer leagues (wood bats).

The total number of line drive injuries to the pitchers from batted balls on the NCAA teams was 8 injuries on 38 teams in 2005 and 9 injuries on 55 teams in 2006, for a total of 17 injuries over the 2 years. The total number of balls in play on these teams was estimated to be 40,500 in 2005 and 58,600 in 2006. Thus, the average rate of line drive batted ball injury for NCAA pitchers was 0.17 per 1,000 balls in play. All of the NCAA injuries over both years were contusions to the arm, hand, foot, or lower leg.

The total number of line drive injuries to the pitchers from batted balls on the summer league teams was 10 injuries on 129 teams in 2005 and 5 injuries on 117 teams in 2006, for a total of 15 injuries over the 2 years. The total number of balls in play on these teams was 119,000 in 2005 and 107,900 in 2006. Thus, the rate of line drive batted ball injury to summer league pitchers was 0.07 per 1,000 balls in play. A majority of the summer league injuries were contusions to the hand, arm, and lower leg. There was also one fractured hand, one fracture to the face, one fractured skull, two contusions to the face, and one concussion. The summer league injuries were more serious than the college team injuries.

The ratio of these rates (NCAA divided by summer leagues) is 2.6, with a 95% confidence interval of 1.3 to 5.2 and a confidence limit ratio of 4.0 with a p-value of 0.005. The current interpretation of this number is that we have too few injuries – based on only 17 NCAA and 15 summer injuries - to reach a definitive conclusion. We are in year 2 of a 3-year study. <u>The only firm conclusion that can be made based on the first two years of data is that the rate of line drive ball injury to a pitcher is low in both the NCAA and the summer leagues</u>.

The injuries in summer league were more severe than the injuries in the NCAA. Furthermore, 5 of the 15 summer league injuries (33%) involved the head and face (compared to none in the NCAA).

2007 DATA COLLECTION

During the 2007 season the study will proceed as in year two. After year three, the results will analyzed, a final report written, and a paper prepared for publication in the medical literature.

Our opinion is that there is a case for renewing the study for an additional 3 years. This is because the rate of injury is even lower than we originally projected. Our opinion is a 6-year study is required to address this issue. If the study were renewed, the results from the first 3 years would be combined with the results from years 4 to 6 to yield approximately 100 injuries. At that point, there would be a much firmer basis for making a definitive statement.

ACKNOWLEDGMENTS

We wish to thank Randy Dick and Jill Corlette at the NCAA for their assistance with providing reports from the NCAA ISS database. We also acknowledge the work of Johna K Mihalik, research assistant on the study and doctoral student in UNC's Sports Medicine Research Laboratory.

Frederick O. Mueller, Ph.D.
Professor, Exercise and Sport Science

Stephen W. Marshall
Associate Professor, Epidemiology

INJURY TYPE AND BODY PART NCAA

INJURY TYPE	BODY PART
2005	
ALL INJURIES WERE CONTUSION TO THE HAND, LOWER LEG, AND FOOT	
2006	
CONTUSION	HAND
CONTUSION	LOWER LEG
CONTUSION	UPPER LEG
CONTUSION	FOOT/TOE
CONTUSION	LOWER LEG
CONTUSION	ANKLE
CONTUSION	UPPER ARM
CONTUSION	HAND/FINGER
CONTUSION	UPPER LEG

INJURY TYPE AND BODY PART SUMMER LEAGUES

INJURY TYPE	BODY PART
2005	
CONCUSSION	HEAD
CONTUSION	ANKLE
CONTUSION	UPPER LEG
CONTUSION	LOWER LEG
CONTUSION	LOWER LEG
CONTUSION	SHOULDER
CONTUSION	FACE
CONTUSION	LOWER ARM
FRACTURE	FACE
FRACTURE	HEAD
2006	
CONTUSION	ANKLE
CONTUSION	FACE
CONTUSION	LOWER LEG
FRACTURE	FACE
FRACTURE	HAND